Biotech Drives Texas Jobs, Economy
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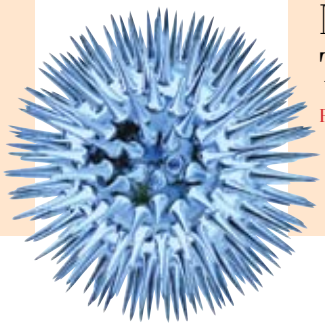

Nanotech in Texas
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FISCAL NOTES

A Monthly Review of the Texas Economy from the Office of Susan Combs, Texas Comptroller of Public Accounts, Jan/Feb 2008

DECEMBER REVENUE (IN MILLIONS): SALES TAX: $1,900.8 OIL PRODUCTION: $99.8 NATURAL GAS: $158.2 MOTOR FUELS: $274.0 MOTOR VEHICLE SALES: $269.0 TOBACCO: $137.9

Easy Web Access

The newly redesigned Texas Comptroller's Web site is easier to use than ever.

Window on State Government now includes easy links to high-traffic sections, taxpayer forms and e-services, granting quick access to our most popular tools. Handy "Quick Start" pages also offer shortcuts to vital information for citizens, businesses and government.

Want to do business with Texas? There are pages on this topic and many more.

Check out: ***www.window.state.tx.us***

INSIDE

Lone Star Nobel-ity

These Texas-based Nobel Prize winners changed the world

While his co-workers vacationed in 1958, a newly hired Texas Instruments engineer named Jack Kilby spent his summer launching a revolution. Fifty years after Kilby unveiled his integrated circuit, it still powers our lives.

Drs. Michael S. Brown and Joseph Goldstein made it their mission to combat the effects of high cholesterol. Their groundbreaking studies revealed how the body metabolizes cholesterol, leading to better cardiovascular health for millions.

Robert F. Curl Jr., his career shaped by a childhood Christmas present, partnered with Richard Smalley and Harold W. Kroto to unearth carbon's third molecular form.

Together, they opened a promising new branch of chemistry.

Johann Deisenhofer turned his back on farming and unraveled photosynthesis.

These Texas-based visionaries' research resonated worldwide, earning each of them the Nobel Prize in the sciences. As new Nobel Laureates collected their prizes in Stockholm in December 2007, we were reminded of previous winners and their contributions to science.

Many Texas-based Nobel Laureates continue to teach, inspiring a new generation. They also bring prestige to universities, attracting top-level faculty and students.

CONTINUED PAGE 10

by **Karen Hudgins**

BioTexas

Biotech drives jobs, economy

From groundbreaking heart drugs to life-saving medical devices, biotechnology is a billion-dollar business in Texas.

Biotechnology in Texas is more than just genetic engineering and pharmaceuticals, says Dr. Mae Jemison. The first African-American woman to go into space, Jemison was aboard the space shuttle Endeavour for a 1992 flight. She is also founder and CEO of Houston-based BioSentient Corp., a medical device company.

"It's a broad range of industries and activities, including medical devices, laboratory testing, and chemical and agricultural industries," she says. "Tie it with the research institutions at Texas A&M and the University of Texas and our medical resources, and it becomes incredibly important."

Earnings generated by the state's biopharmaceutical industry will reach $1.3 billion annually by 2014, according to the Milken Institute.

"The beauty of Texas is that we are so big and so diverse in biotechnology," says Tom Kowalski, president of the Texas Healthcare and Bioscience Institute. "If we look at West Texas, bioagriculture is big. If we go to Houston, cancer [research] is huge. In Dallas, there's a large medical device component."

High-Tech Farming

The state's agricultural biotechnology sector is working on advances such as using genetics to increase crop yields and enhance nutritional value. In fiscal 2005, Texas public higher education institutions spent $87.2 million for agricultural sciences research and development, reports the Texas Higher Education Coordinating Board.

Food biotechnology combines crop breeding with genetic engineering to produce a heartier, higher-yielding crop, says Lona Sandon, an assistant professor at UT Southwestern Medical Center.

"Now, with sophisticated scientific techniques, a gene with the desired trait from one plant can be inserted into another using a living organism," Sandon says.

Scientists have used biotechnology to improve soybeans, corn, cotton and other crops. In 2004, Texas grew more acres of genetically modified cotton than any state in the nation, with 3.4 million acres, reports the Pew Initiative on Food and Biotechnology.

Cutting-Edge Research

In 2005, the state's academic institutions and businesses ranked sixth in the nation for National Institutes of Health grants, which primarily supply biotechnology funding, with $1.15 billion.

At Texas A&M University's Institute of Biosciences and Technology (IBT) in Houston, more than 200 scientists and staff from around the world search for cures for cancer, heart failure, stroke and birth defects. Three biotechnology companies have sprung from IBT research, including Inhibitex, which develops pharmaceuticals to treat infectious diseases.

IBT Director Robert Schwartz says his charge is "to enhance our ability to transfer basic research to the marketplace. The idea is to use our influence and our science to create more jobs for Texans."

UT Southwestern Medical Center's Office for Technology Development develops and commercializes intellectual property and creates regional biotechnology companies. OTD has launched several biotechnology companies, including Reata Pharmaceuticals Inc., says Dr. Dennis Stone, vice president of technology development at UT Southwestern.

In 2008, UT Southwestern will break ground on an adjacent 13-acre complex to its Dallas campus that will support biotechnology ventures.

"We plan to ultimately build about a 500,000 square-foot complex that will house our companies, companies that might want to locate here and strategic partners in the biotechnology/bio-device space," Stone says.

Biotech Salaries

Texas boasts more than 900 biotechnology, biomedical research and medical manufacturing companies, universities and research centers that employ 78,896 workers at an average salary of $68,293.

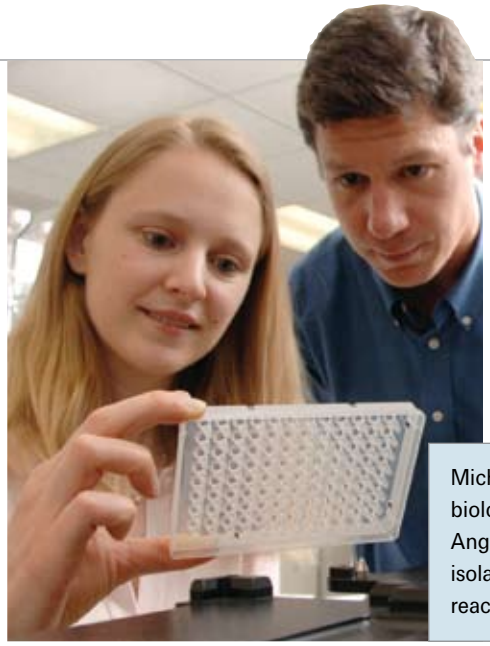
Source: The Office of the Governor's 2007 *Texas Biotechnology Industry Report*

Funding the Future

The state has backed its biotechnology industry with substantial resources, according to the Governor's 2007 *Texas Biotechnology Industry Report*. In 2001, the Texas Legislature appropriated $800 million for science, engineering and commercialization, including $385 million for research infrastructure. In 2005, the State's Emerging Technology Fund (ETF) was created to promote innovations in high-tech industries. Since then, the ETF has awarded $18.8 million to biotechnology projects.

"We have some wonderful policies that have been passed by the Legislature that are allowing us to invest in this particular industry," says Kowalski. "And that is making us very competitive, not only nationally but also globally."

For more information on biotechnology in Texas, visit the Office of the Governor, Economic Development and Tourism Division at *www.governor.state.tx.us/divisions/ecodev* or the Texas Healthcare and Bioscience Institute at *www.thbi.org*. FN



Michael White (right), professor of cell biology at UT Southwestern Medical Center, and Angelique Whitehurst, postdoctoral researcher, isolate genes that affect how human cancer cells react to certain chemotherapy drugs.

From Medicines to Machines

The Governor's Office divides the state's biotechnology market into several industry segments, including life sciences, biomedicine and pharmaceuticals, medical devices, agriculture and the environment. Biomedicine and pharmaceuticals is the largest area, with about 135 pharmaceutical manufacturing companies employing more than 9,500 workers. Another 1,762 medical research and testing laboratories employ 35,212 workers, according to the Texas Workforce Commission.

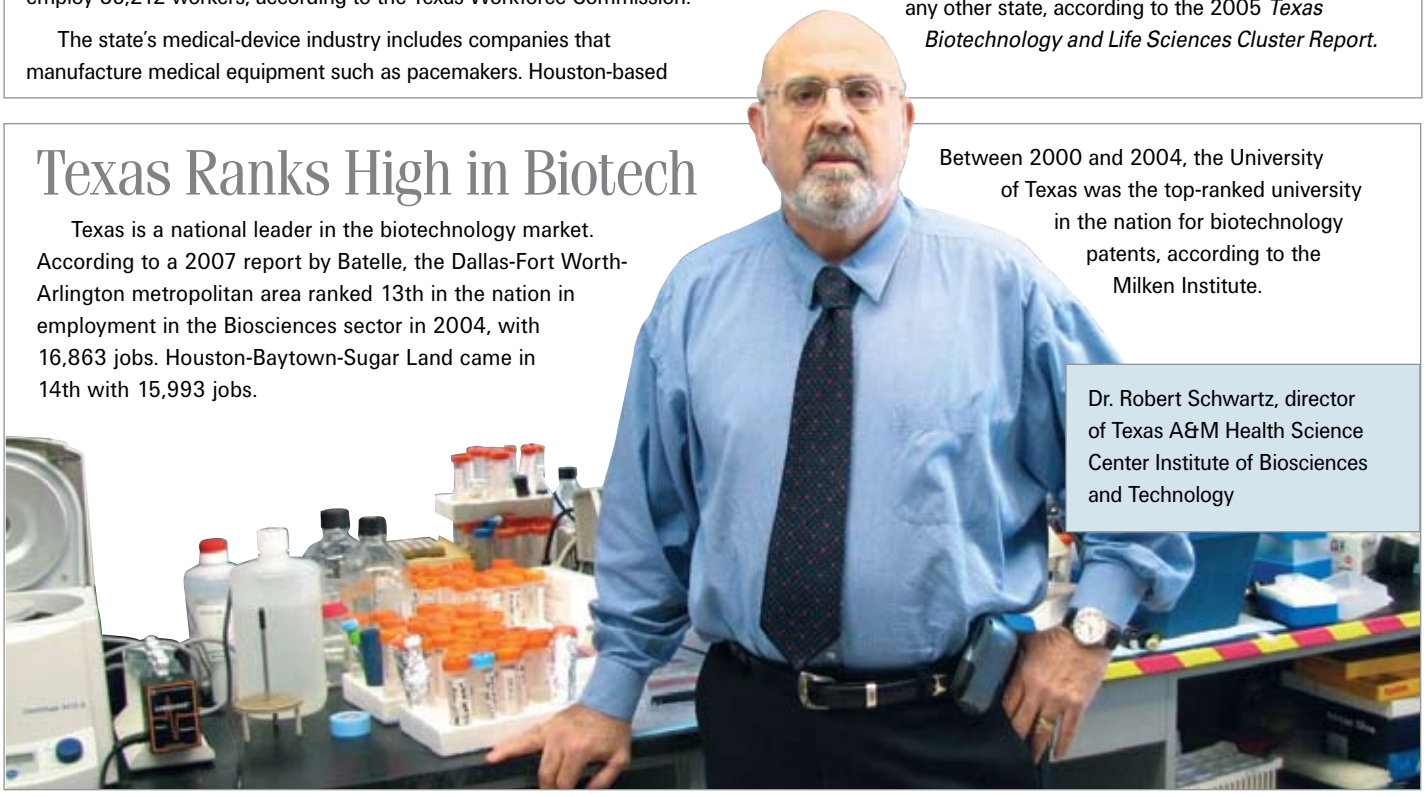
The state's medical-device industry includes companies that manufacture medical equipment such as pacemakers. Houston-based medical device maker Cyberonics developed the first FDA-approved electro-medical device for treating epilepsy. Trials under way are using the device to treat obesity, bulimia and Parkinson's disease as well, says Cyberonics CFO Greg Browne.

In 2005, Texas counted 2,782 clinical trials for global and domestic pharmaceutical and biotechnology firms, more than any other state, according to the 2005 *Texas Biotechnology and Life Sciences Cluster Report.*

Texas Ranks High in Biotech

Texas is a national leader in the biotechnology market. According to a 2007 report by Batelle, the Dallas-Fort Worth-Arlington metropolitan area ranked 13th in the nation in employment in the Biosciences sector in 2004, with 16,863 jobs. Houston-Baytown-Sugar Land came in 14th with 15,993 jobs.

Between 2000 and 2004, the University of Texas was the top-ranked university in the nation for biotechnology patents, according to the Milken Institute.



Dr. Robert Schwartz, director of Texas A&M Health Science Center Institute of Biosciences and Technology

by **Bruce Wright**

From Texas to the Moon

Orion will boost state economy

By the year 2020, a manned spacecraft called Orion should leave Earth's orbit, bound for the Moon. The mission will be man's first venture into deep space in nearly 50 years. And Texas workers will have played an important role in getting it there.

Orion is the spearhead of the National Aeronautics and Space Administration's (NASA's) "Vision for Space Exploration," a long-term commitment to the human exploration of the Moon and Mars first announced by the Bush administration in January 2004. The Houston area's Lyndon B. Johnson Space Center is managing the project.

Orion's development will bring several thousand new jobs and other significant benefits to the Texas economy, which already nets about 17,000 jobs and more than $3 billion in annual spending from NASA operations.

Orion and Constellation

The Orion spacecraft is part of a larger program called Constellation, an initiative intended to lead both to renewed exploration of the Moon and eventually a human Mars mission. As planned, Constellation also will include two new rockets, both partly based on existing Space Shuttle technology: the Ares 1, a slender, two-stage vehicle designed to carry Orion into orbit; and the Ares V, a mammoth "heavy lifter" roughly the size of the old Saturn V, which will carry a lunar lander.

The Orion vehicle will bear a strong resemblance to the Apollo command and service modules. Like Apollo, Orion will have a launch abort system able to carry the craft clear of any emergency during takeoff, making it potentially safer than the shuttle.

According to NASA, Orion will be much roomier than Apollo, providing its crews of four to six astronauts with two-and-a-half times as much room as the earlier vehicle.

Perhaps the biggest difference, though, will be its electronics. While Apollo went to the Moon with less computing power than today's cheapest cell phone, Orion will have a full array of the latest data technology and avionics systems.

ARES I
CREW LAUNCH VEHICLE
- About 25 metric tons payload capacity
- 2 million pounds gross liftoff weight
- 309 ft in length

ARES V
CARGO LAUNCH VEHICLE
- About 130 metric tons payload capacity
- 7.4 million pounds gross liftoff weight
- 358 ft in length

Bay Area Benefits

Orion will bring significant benefits to Houston's Bay Area, says Bob Mitchell, aerospace marketing director for the Bay Area Houston Economic Partnership. Lockheed Martin Corp., a major contractor for the Orion program, plans to create about 900 new jobs in the area and to make $68 million in new capital investments.

Lockheed Martin's stake in the area increased considerably due to aggressive courting by state and local officials. The company initially proposed to create 350 to 400 jobs in the region.

"Originally, the company was just going to do limited design and development work in Texas," Mitchell says. "But the work that Lockheed Martin is going to be doing here now is developing all of the software and avionics for the entire program. This is a much bigger piece of the pie than we ever had on the shuttle when it was originally developed."

"Houston's base of skilled aerospace workers, experienced technicians and strong community support are unique and hard to beat," says John Karas, vice president for Human Space Flight at Lockheed Martin Space Systems. "Combine that with the strong support and willingness of the state and local communities and business organizations to partner with Lockheed Martin through economic incentives, and it made

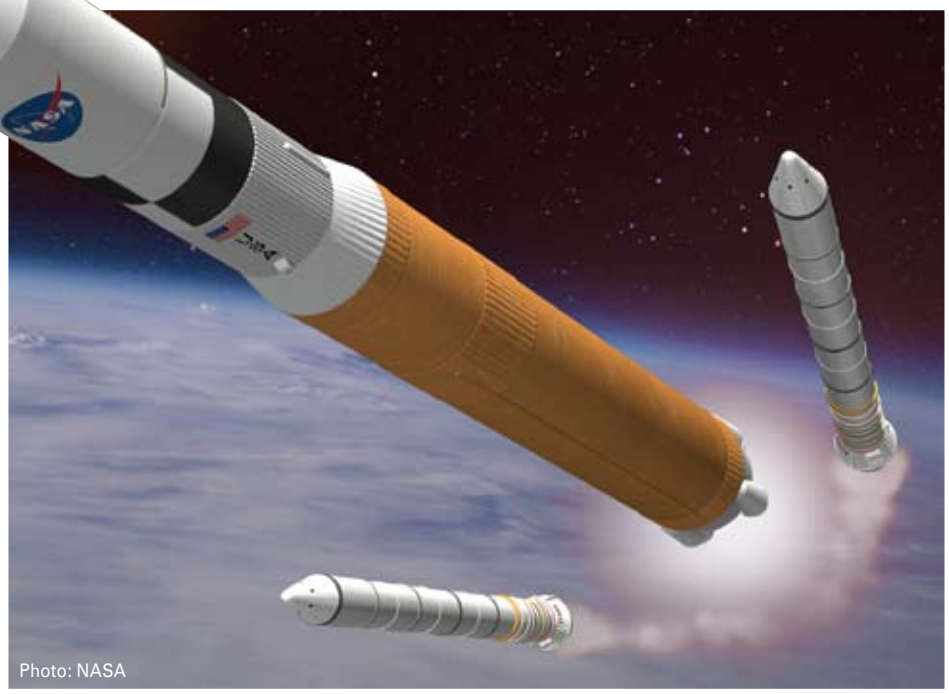


Photo: NASA

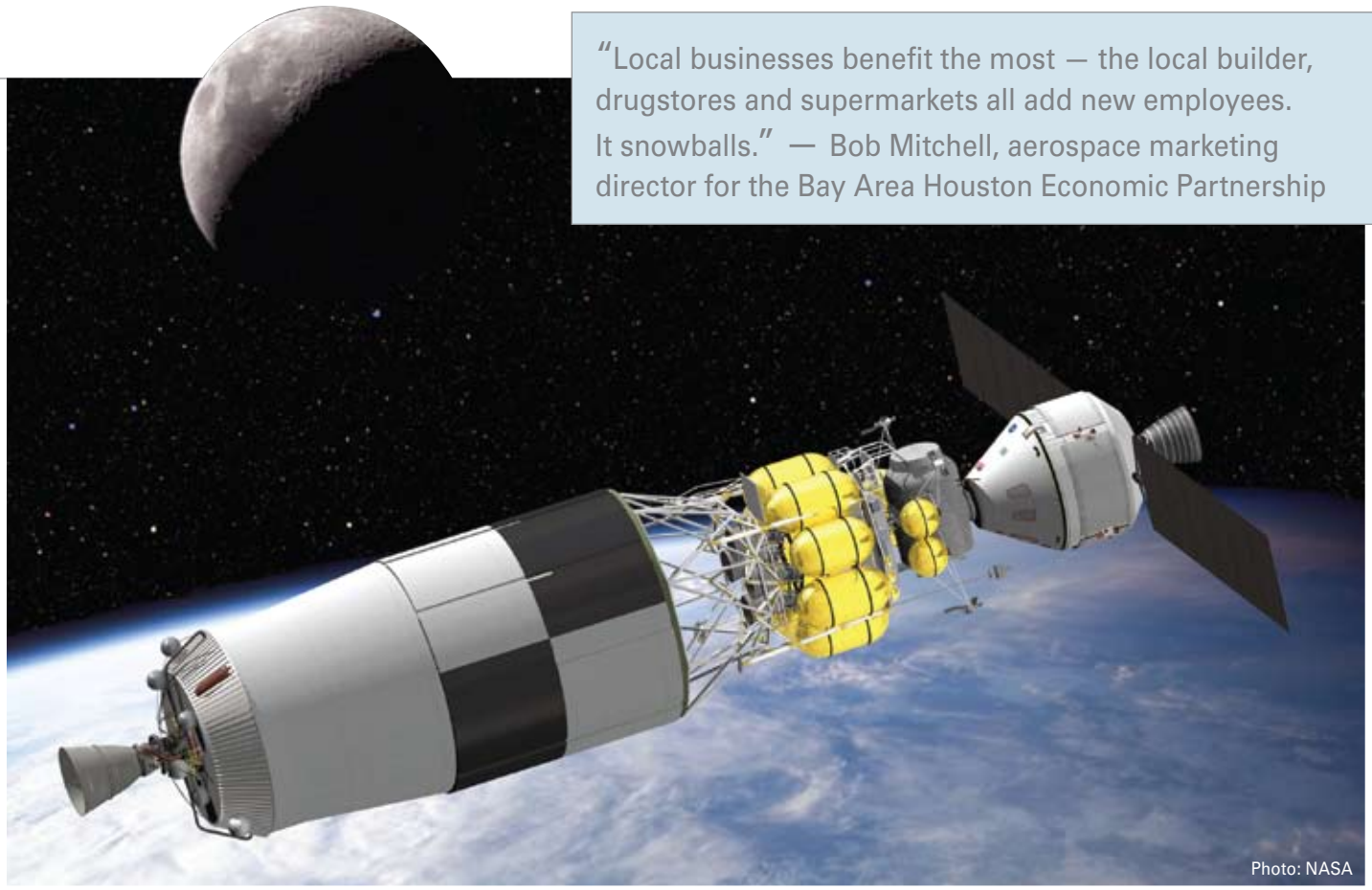


Photo: NASA

> "Local businesses benefit the most — the local builder, drugstores and supermarkets all add new employees. It snowballs." — Bob Mitchell, aerospace marketing director for the Bay Area Houston Economic Partnership

perfect sense for us to establish our Orion program office in Houston."

New Jobs, New Workers

The Orion program's impact will extend well beyond the Lockheed Martin work force.

"It's all in the jobs that will support those 900 new jobs," says Mitchell. "Local businesses benefit the most — the local builder, drugstores and supermarkets all add new employees. It snowballs." Bay Area Houston estimates that the Orion project will generate an additional 2,600 jobs in the area and more than $535 million in annual spending.

Lockheed Martin also plans to make significant commitments to Texas educational institutions to begin preparing a new generation of aerospace workers.

"The need to develop and train engineers, scientists and mathematicians is a compelling requirement for NASA's Vision for Space Exploration," says Cleon Lacefield, Lockheed Martin's vice president for Project Orion. "At the University of Houston at Clear Lake and the surrounding Clear Creek Independent School District, we will take advantage of their growing expertise in software and power systems. The students will develop and deliver power system test beds and math models for the Orion program.

"We're also establishing similar programs at the University of Texas at El Paso," Lacefield continues. "And since today's elementary school students will form the nucleus of tomorrow's high-tech work force, we plan to develop cooperative programs with school districts in the greater Houston area."

The ultimate earthbound benefits of the new space initiative, though, may come from technologies not yet imagined.

"There are going to be new industries that will be developed because of the Constellation program," Mitchell says. "To get back to the Moon and stay on it for long periods of time is going to require a lot of new technology.

"It's going to require new types of fuel cells," he says. "There's going to have to be a habitat built, which is another new industry we've never had before. The technology that's going to be developed through those activities is going to create a lot of new industry in this community."

Back to the Future

In the space community, excitement about Orion is growing.

"We're very proud to be partnered with NASA and with the state of Texas on the Orion program as we embark upon the most exciting space adventure yet to unfold," says Lockheed's Karas. "Since the days of Apollo and before, Texas has played a central role in our nation's space program. Today, we're ready to take the next leap forward."

"What it means is the reality of going back to the Moon, to Mars and beyond," says Mitchell. "We are a technology-driven economy in a global market. That's who we are, and we've got to stay in front of everybody else. And space exploration is a driver in that technology." FN

by **David A. Rivers**

Eyes in the Skies

Planes without pilots take off

Nearly all of the planes made since the Wright brothers first flew have had one component in common: a pilot. But human pilots are becoming less necessary today.

Take the TR-918 Eagle Eye, a tilt-rotor aircraft built by Bell Helicopter in Fort Worth. The Eagle Eye, which is currently awaiting a purchase decision by the U.S. Coast Guard, can conduct surveillance and reconnaissance missions in all weather conditions without endangering a human pilot.

"A concept developed for use with the Coast Guard was to carry the Eagle Eye on their cutters," says Mike Cox, a spokesman for Bell Helicopter. "When they wanted to see what was miles beyond their view, they would launch the Eagle Eye and gain a much greater search capability. The tilt-rotor eliminates the need for a runway, and the craft can land back on the ship automatically."

While unmanned aerial vehicles (UAVs) such as the Eagle Eye may seem futuristic, they aren't an entirely new idea. A few rudimentary remote-controlled aircraft were built and tested as early as World War I.

UAV Research and Technology

Developments in digital computer technology, robotics and miniaturization help today's pilotless flying robots work. Jeff Hostetler, a lecturer in the Aerospace Engineering Department at Texas A&M University, reports that much of today's UAV research and development has centered around the miniaturization of avionics systems and the refinement of small-motor technology.

Miniaturization has produced dramatic reductions in the size and weight of avionics equipment.

"There has also been a lot of development effort in the use of small, very reliable, high-output motors," Hostetler says. "These engines are typically used in the smaller UAVs, from hand-launched craft on up to UAVs with wing spans up to 10 feet."

The Department of Defense expects to spend $10 billion annually by 2010 on UAV research and related technologies, and to quadruple its use of these craft in the field. This will boost business opportunities for Texas companies involved in the development or manufacture of guidance systems, autopilot solutions, precision control technology and real-time mission programming.

On the Radar Screen

With the beginning of military operations in Afghanistan and Iraq, U.S. defense funding for research into pilotless aircraft started flowing in extraordinary amounts, spurring the development of new types of these specialized vehicles.

These aircraft can fly specific, predetermined missions and return to base. Some, like the Air Force MQ-1 Predator, can be remotely controlled from a local battlefield or from a distant command center such as Nevada's Nellis Air Force base, thousands of miles from the action.

Bell Helicopter's tilt-rotor UAV, the Eagle Eye, can take off vertically, transition quickly to horizontal flight and race to its destination at more than 200 knots, nearly 80 knots faster than conventional helicopter UAVs.

Photo: Bell Helicopter

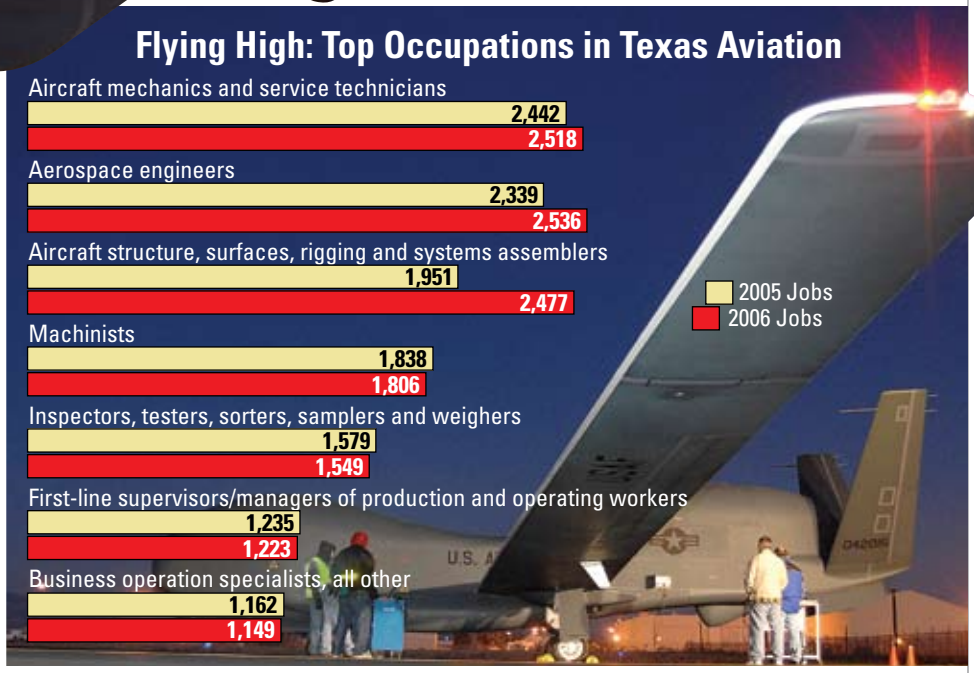
The Northrop Grumman RQ-4 Global Hawk UAV is a high-altitude, high-endurance reconnaissance aircraft that can fly at altitudes up to 65,000 feet for more than 40 hours.

Photo: Northrop Grumman

UAV types include a wide range of vehicles, from handheld, hand-launched machines such as the U.S. Marine Corps' Dragon Eye to the U.S. Air Force's long-endurance, all-weather RQ-4 Global Hawk. The Global Hawk can patrol thousands of miles of territory at high altitude, sending intelligence to designated ground stations.

While UAVs are still primarily used in their traditional roles of surveillance, reconnaissance and target drones, a new generation is taking on more aggressive missions. Unmanned Combat Aerial Vehicles that can be equipped with Hellfire missiles, bombs and other types of ordnance are already looking for trouble in hostile skies. FN

Flying High: Top Occupations in Texas Aviation



Source: EMSI Complete Employment

by **Bruce Wright**

Small is Big

Nanotech in Texas

A scientific and technological revolution promises to produce the biggest changes in our daily lives since the rise of computer technology.

The revolution is nanotechnology, which is expected to have a trillion-dollar impact on the world economy within a few years. And Texas is in the forefront of the research and development needed to fulfill its promise.

Nanotech is not a single science or engineering discipline, but an approach that involves — and is changing — many fields of knowledge. According to Rice University, a world leader in the field, nanotech involves understanding, manipulating and building structures from individual atoms and molecules — structures in the range of one to 1,000 nanometers in size. A nanometer is one-billionth of a meter; a human hair is about 80,000 nanometers wide.

From Atoms to Products

Items produced with nanotechnology are already on store shelves. According to the National Nanotech Initiative (NNI), a collaborative effort among federal agencies, about $60 billion to $70 billion worth of such products are sold in the United States each year, and the numbers are rising quickly.

The Project on Emerging Nanotechnologies estimates that by 2014, nanotechnology will be incorporated in about $2.6 trillion in manufactured goods — about 15 percent of the global economy.

Current products incorporating nanomaterials include things from computer hard drives to bandages. But more important breakthroughs are on their way.

Scientists at Rice and the M.D. Anderson Cancer Center are developing a way to attack cancer by putting a payload of anticancer drugs into buckyballs and embedding them in antibodies that target cancer cells. Such methods could treat cancer without the debilitating effects of conventional chemotherapy.

"Nanotechnology is pervasive — it will improve so many things," says Kelly Kordzik, president of the Texas Nanotechnology Initiative, an industry consortium.

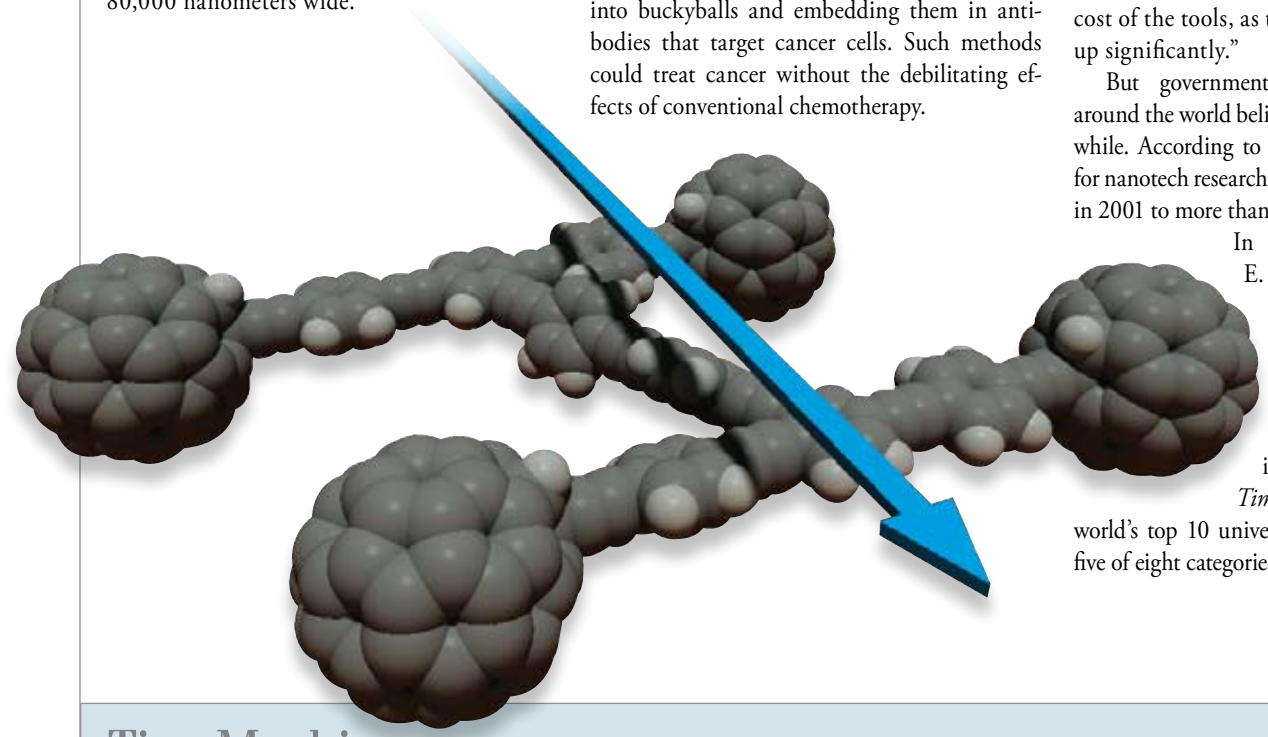
"The computer world is going to have to rely on nanotechnology to get to the next level, to keep getting faster, smaller and cheaper computers," he says. "With nanotech, we can engineer solar cells to be more efficient. It will enable batteries to be more efficient and more powerful, and will [make] hydrogen fuel cells viable."

Big Bucks for Tiny Discoveries

Cutting-edge research into nanotechnology is expensive. "To get a leading-edge electron microscope these days can cost $15 million or $16 million," says Walt Trybula, director of the Nanomaterials Application Center (NAC) at Texas State University-San Marcos. "The cost of the tools, as they get more precise, goes up significantly."

But governments and private industries around the world believe the investment is worthwhile. According to NNI, U.S. federal funding for nanotech research has risen from $464 million in 2001 to more than $1 billion in 2006.

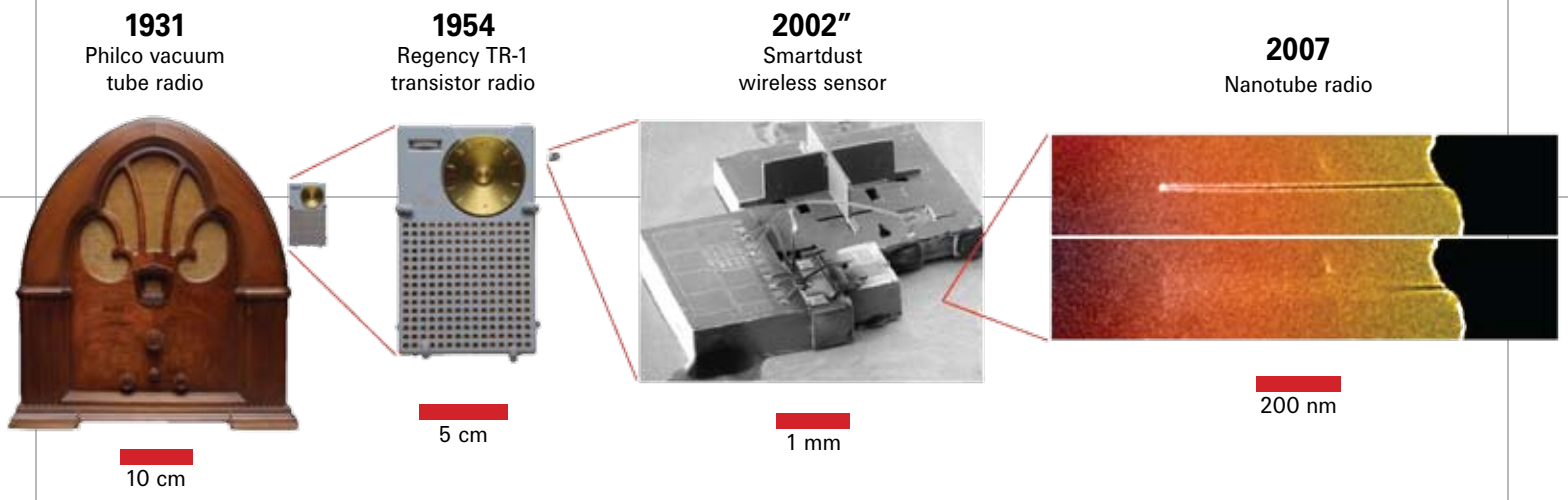
In Texas, Rice's Richard E. Smalley Institute for Nanoscale Science and Technology continues to hold the leading position in nanotech research. A 2007 assessment in the industry publication *Small Times* placed Rice among the world's top 10 university nanotech programs in five of eight categories.



Tiny Machines

Just 16 years after an IBM scientist first manipulated atoms to spell the company logo, Rice University scientist James M. Tour built a car, complete with a chassis, axles and rotating "buckyball" wheels, out of a single carbon molecule. Twenty thousand of the tiny vehicles could be lined up across the width of a single human hair.

Tiny devices may have real-world uses. Scientists are working toward applications such as tiny solar cells that can be embedded in roofing tiles or mixed into house paint, implantable systems that monitor drug levels in the bloodstream and nanoscale semiconductors that could open the way for infinitely more powerful computers.



Think an iPod is Small?

Scientists at the University of California at Berkeley recently announced that they had succeeded in placing a working radio, tunable to AM or FM stations, inside a single carbon nanotube. About 10,000 of these radios could be laid across the width of a single human hair.

To hear a song played on the nano-radio, visit the Web site of the Center of Integrated Nanomechanical Systems at UC-Berkeley at *www.physics.berkeley.edu/research/zettl/projects/nanoradio/radio.html*.

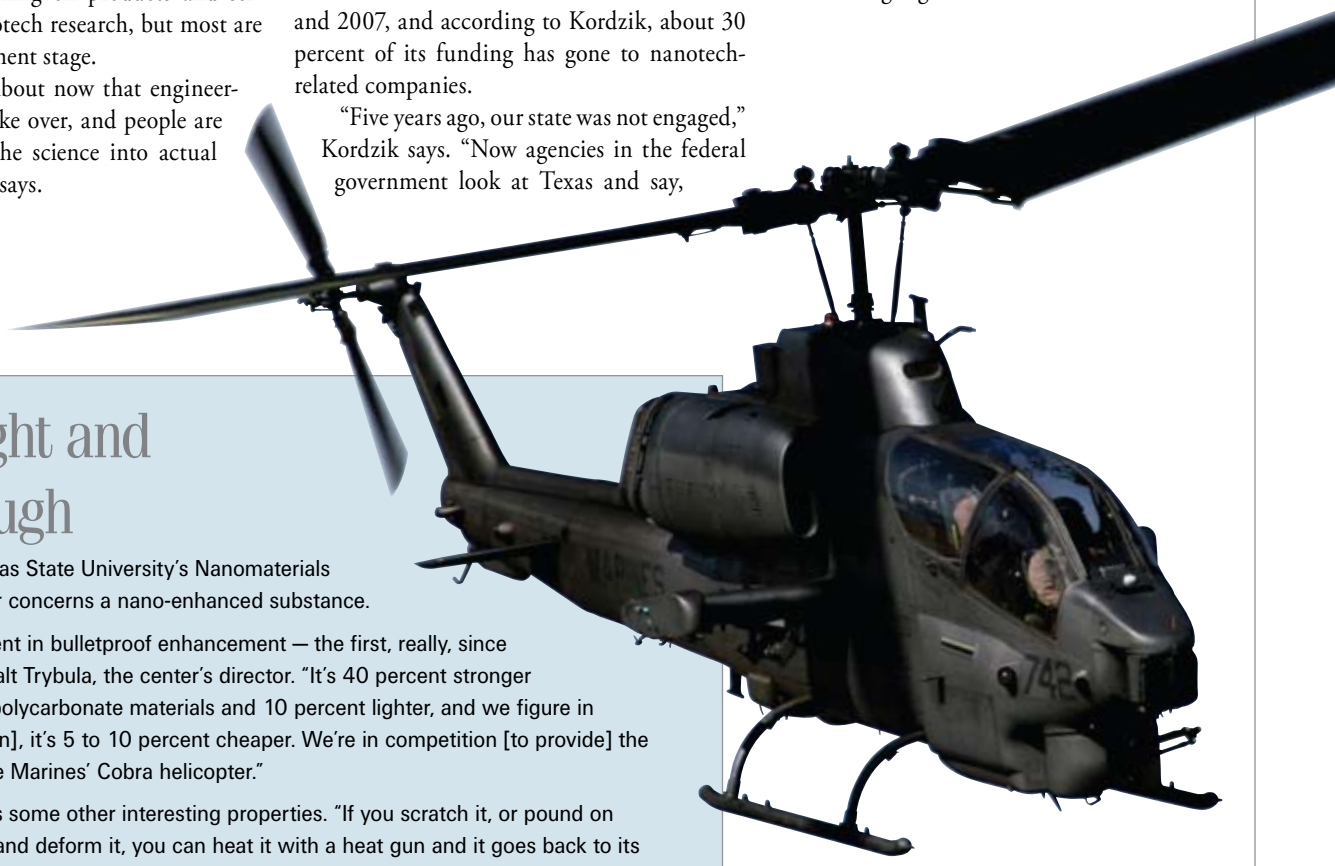
Out of the Lab

Moving from research to the marketplace can be difficult. The Nanotechnology Foundation of Texas reports that at least 30 Texas companies are working on products and services based on nanotech research, but most are still in the development stage.

"It's only just about now that engineering is starting to take over, and people are trying to convert the science into actual products," Kordzik says.

The state's Emerging Technology Fund (ETF) can provide valuable support for projects that promise medical or scientific breakthroughs or that are likely to lead to high-quality new jobs. The ETF received $200 million for fiscal 2006 and 2007, and according to Kordzik, about 30 percent of its funding has gone to nanotech-related companies.

"Five years ago, our state was not engaged," Kordzik says. "Now agencies in the federal government look at Texas and say, 'Man, you guys have got it goin' on.' They see in us a huge amount of cooperation between big companies, small companies, universities and state government. They see that we really are working together as a team." FN



Very Light and Very Tough

One project at Texas State University's Nanomaterials Application Center concerns a nano-enhanced substance.

"It's an improvement in bulletproof enhancement — the first, really, since the `60s," says Walt Trybula, the center's director. "It's 40 percent stronger than the existing polycarbonate materials and 10 percent lighter, and we figure in volume [production], it's 5 to 10 percent cheaper. We're in competition [to provide] the windshields on the Marines' Cobra helicopter."

The substance has some other interesting properties. "If you scratch it, or pound on it with a hammer and deform it, you can heat it with a heat gun and it goes back to its original shape," says Trybula.

by **Tracey Lamphere**

CONTINUED FROM PAGE 1

Lone Star Nobel-ity

The Economics of Research

While it's difficult to pinpoint just how much economic impact Nobel Laureates have on a university, schools can expect to see a spike in alumni donations when one is present, says Tom Saving, a Texas A&M economics professor.

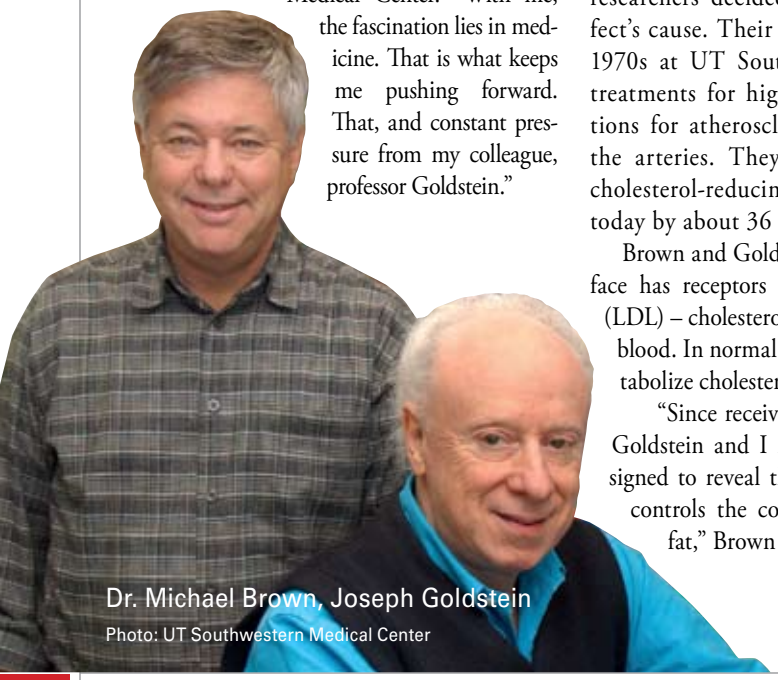
"From the view of alumni giving, having a Nobel Prize winner is very much like winning a national title in football," Saving says.

Generally, universities want to attract the best and brightest faculty, whose research might one day win national or international acclaim, Saving says.

Scientific and medical research among universities is big business. For instance, each dollar spent by The University of Texas Southwestern Medical Center at Dallas generates $2.14 for the economy, according to UT-Southwestern figures. For each $1 million worth of research funded by external sources, 41.6 jobs are generated with a total of about 13,770 jobs so far. Every $1 million of research funding generates $3 million of business activity for the state's economy, according to figures provided by UT-Southwestern.

Quest for Knowledge

"Certain people can never rest until they have answers to fundamental questions about the nature of the universe," says Dr. Brown, a physician, professor and director of the Jonsson Center for Molecular Genetics at the UT-Southwestern Medical Center. "With me, the fascination lies in medicine. That is what keeps me pushing forward. That, and constant pressure from my colleague, professor Goldstein."



Dr. Michael Brown, Joseph Goldstein
Photo: UT Southwestern Medical Center

Nobel Facts

The Nobel Prize was established in 1901 in the will of Alfred Nobel (1833-1896). Nobel, the father of dynamite, used his wealth to establish the prizes that honor the significant contributions to physics, chemistry, physiology or medicine, literature and peace.

In 2007, each Nobel Prize came with 10 million Swedish Krona, about $1.5 million.

As of 2007, 797 Nobel laureates have been named, including 20 organizations.

Thirty-four recipients have been women and include Marie Curie (1903), Mother Teresa (1979) and Pearl Buck (1938).

UT Southwestern Medical Center in Dallas has four Nobel Laureates on its faculty, the most of any medical school in the world.

Source: *www.nobelprize.org*

As postdoctoral associates at the National Institutes of Health, Brown and Goldstein saw 6- and 8-year-old siblings with high cholesterol and repeated heart attacks. The researchers decided to find the genetic defect's cause. Their work, which began in the 1970s at UT Southwestern, instigated new treatments for high cholesterol and preventions for atherosclerosis, a disease affecting the arteries. They laid the foundation for cholesterol-reducing medications consumed today by about 36 million Americans.

Brown and Goldstein found that a cell's surface has receptors for low-density lipoprotein (LDL) – cholesterol-containing particles in the blood. In normal cells, the receptors help metabolize cholesterol.

"Since receiving this award in 1985, Dr. Goldstein and I have conducted studies designed to reveal the ways in which the body controls the conversion of foodstuffs into fat," Brown says.

The Monolithic Idea

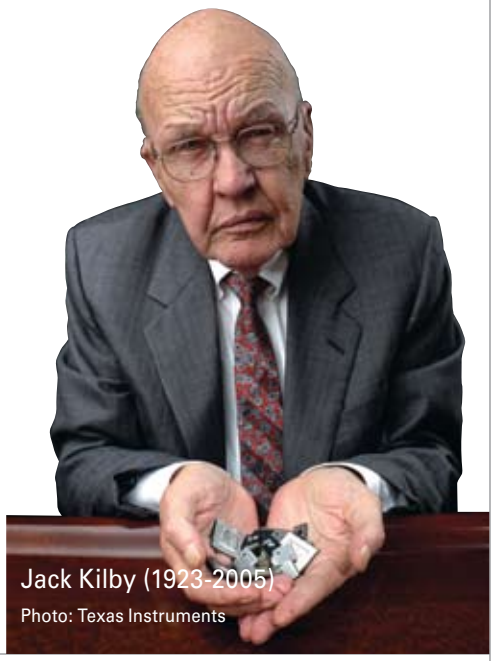
When Jack Kilby joined Texas Instruments (TI) in 1958, what passed for high technology relied on vacuum tubes and individual transistors. Using items on hand, Kilby built the first integrated circuit – the predecessor of the silicon chips found in virtually all modern electrical devices – at TI's semi-conductor lab. (Robert Noyce is recognized for similar work in California at about the same time.)

"In 1958 my goals were simple: to lower the cost, simplify the assembly and make things smaller and more reliable," Kilby said in his 2000 Nobel Prize acceptance lecture. "Although I do not consider myself responsible for all of the activity that has followed, it has been very satisfying to witness the integrated circuit's evolution."

Kilby died in 2005.

Before Kilby, electronic circuits were assembled manually from separate components. "The Monolithic Idea," as Kilby's sketches became known, was to create components incorporating multiple transistors on a thin layer of semiconductor material.

Kilby tested his prototype in the lab on Sept. 12, 1958, but met with considerable skepticism. Kilby would joke he was the entertainment at conferences because people laughed, recalls Bob Doering, TI senior fellow and technology strategy manager.



Jack Kilby (1923-2005)
Photo: Texas Instruments

The impact of Kilby's integrated circuit has affected every facet of industry. Since 1961, the worldwide electronics market has grown from $29 billion to more than $1.4 trillion. While Kilby's circuit contained one transistor, today TI's microchips can hold up to a billion.

Carbon Copy

Robert Curl Jr.'s interest in the sciences began early in life.

"I got a chemistry set for Christmas when I was about 9 years old," he says. He also credits his San Antonio Thomas Jefferson High School chemistry teacher, Lorena Davis, for further igniting his interest. In 1996, he, fellow Rice professor Smalley and Kroto (Sussex, England) received the Nobel Prize in chemistry for discovering fullerenes, a new carbon family. Before that, people believed carbon had two forms: graphite and diamond.

The Buckminsterfullerene, so named and nicknamed the "Buckyball" due to its resemblance to the geodesic dome designed by R. Buckminster Fuller, has 60 carbon atoms arranged in a spherical formation. This discovery spawned a new branch of chemistry that is working to unlock the commercial potential of buckyballs and the related, cylindrical form called the carbon nanotube.

Smalley, who died in 2005, developed a machine that used a pulsed laser to examine atom clusters. Curl says Smalley was confident they would find something during their experiments in September 1985, and they did.

Curl compares researchers to gold prospectors: "They would dream of finding gold in them thar hills."

During his career, Curl has seen opportunities for budding scientists expand. In the 1940s, science fairs and undergraduate research programs were virtually nonexistent.

"New generations of researchers are always welcome," he says. "Science is an ongoing process."

A Molecular Marvel

Instead of running his family's farm in his native Germany, Johann Deisenhofer tackled science, producing a body of work that professor Bo G. Malmström of the Royal Swedish Academy of Sciences called "a giant leap in our understanding of fundamental reactions in photosynthesis, the most important chemical reaction in the biosphere of our earth."

Originally from Zusamaltheim, Germany, Deisenhofer joined UT Southwestern Medical Center as a biochemistry professor in 1988, eight months prior to receiving the Nobel Prize. His research discovered a protein-based structure within cells that plays a crucial role in photosynthesis.

"In my view, scientific research is a deeply cultural activity," Deisenhofer says. "Everyday, we experience the limits of our current knowledge about the world around us. It is a great privilege to be in a position to push back these limits by a little. It is worth every effort."

Deisenhofer says photosynthesis' importance and the chance to work with Hartmut Michel, who shared the Nobel with Deisenhofer and Robert Huber, influenced his pursuit of the subject.

"There were many doubters who thought what we attempted to do was impossible," Deisenhofer says. With increasing activities outside the laboratory, such as travel and lectures, he has stopped working in the lab and now helps young collaborators with advice and direction. While not all of these Nobel Laureates were based in Texas at the time of their groundbreaking research and discoveries, their presence here now demonstrates the state's attractiveness to innovative minds.

For information, visit *www.nobelprize.org.* FN

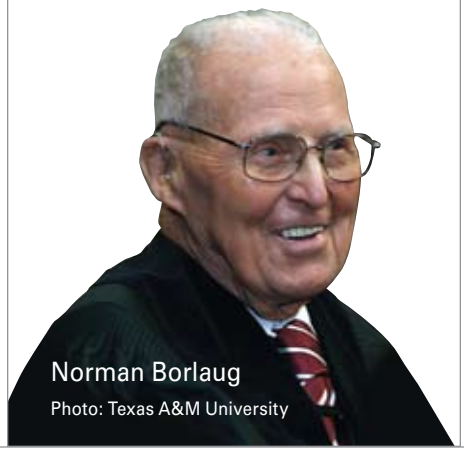
Science and Service

While Texas has had its share of Nobel Laureates in the science fields, it is also home to a Nobel Peace Prize winner. Norman Borlaug, a distinguished professor at Texas A&M, is credited with saving millions of people from starvation by developing a dwarf wheat variety. The wheat was more resistant to disease and pests and produced higher yields, helping launch a Green Revolution in the 1960s.

The award is made to the person who, during the preceding year, "conferred the greatest benefit on mankind." Borlaug received the prize in 1970.

Robert Curl Jr.
Photo: Rice University

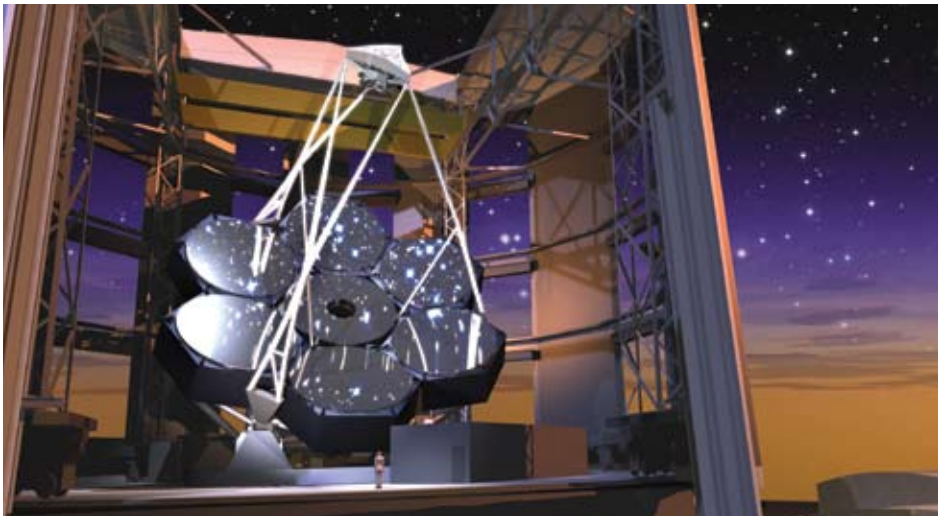
Johann Deisenhofer
Photo: UT Southwestern Medical Center



Norman Borlaug
Photo: Texas A&M University

by **Editorial Team**

Brief Bytes



Bird's Eye View

Texas A&M University, the University of Texas at Austin and other institutions plan to build the world's largest telescope on an icy mountaintop in Chile.

The Giant Magellan Telescope (GMT), scheduled for completion in 2016, is being called the first of a new generation of ground-based telescopes. It will contain seven perfectly polished mirrors, each 27.5 feet in diameter. Six of the mirrors will surround the seventh, similar to the petals of a flower, in an arrangement that will allow them to act as a single mirror more than 80 feet wide.

Scientists expect the $500 million GMT to let them to see farther — and thus deeper into the universe's infancy — than ever before.

(Bruce Wright)

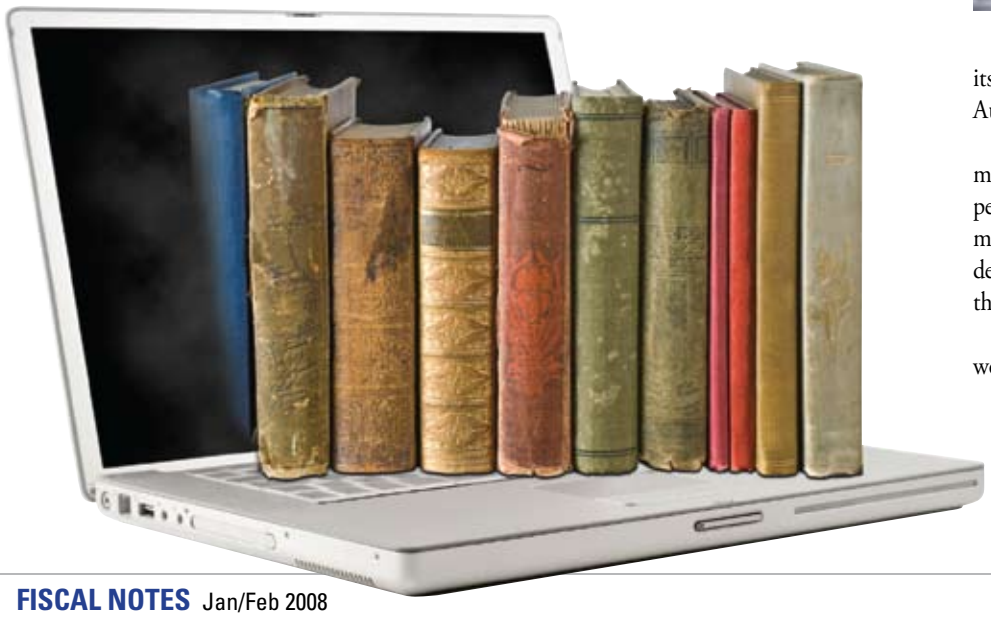
Portal on Our Past

The University of North Texas has created a unique resource for students, scholars and Texas-history buffs: the Portal to Texas History, a Web site maintained by the university libraries' Digital Projects Unit.

The portal contains more than 100,000 content pages offering historically important texts and images, including the texts of more than 300 books; vintage newspapers, diaries and letters; about 200 maps; and nearly 14,000 photographs. It also offers 20 online lesson plans allowing teachers to integrate the portal's resources with their curricula.

To browse through this unprecedented collection, visit *www.texashistory.unt.edu*.

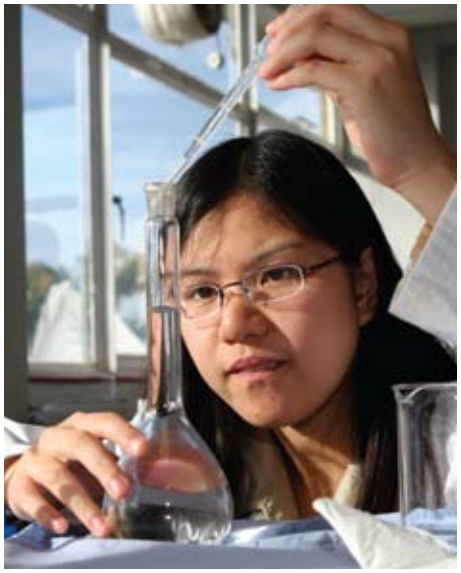
(Bruce Wright)



High-Tech High School

Technical training is a high priority for tomorrow's work force. State officials hope to address this need with the $80 million Texas Science, Technology, Engineering and Math Initiative, a program intended to spark innovative educational ideas and produce at least 3,500 graduates each year who will pursue careers in various science, engineering and technical disciplines.

One part of the initiative, which is backed by a combination of state and federal funding and private donations, will create 35 Texas Science, Technology, Engineering and Math (TSTEM) academies across the state. Fifteen of these academies opened in fall 2007.



Manor Independent School District opened its 167-student New Technology High School in August, and it's already creating a buzz.

"Students are thrilled with the new instructional methodology," says Mark Diaz, Manor ISD's superintendent. All of the work there is project-based, much like work in the real world. For example, students were asked to create promotional posters for the school using the latest design software.

"The students were almost arguing about who would make their presentation first," Diaz says.

(Tracey Lamphere)

Follow the Money Trail

Want to know how your state tax dollars are being spent? You no longer have to wait until the state's Annual Cash Report is published at the end of the fiscal year. Now you can go online anytime and view state expenditures on the Window on State Government Web site *www.window.state.tx.us*.

The 80th Texas Legislature approved legislation calling for the creation of a Web-based, searchable database of state expenditures. The result, the Comptroller's "Where the Money Goes" Web site, has been operating since Oct. 1.

"We have always provided the information by request. But now, with Where the Money Goes, the information is available with just a few clicks of the mouse," Suzy Whittenton, director of Fiscal Management for the Texas Comptroller's office, says.

(David Rivers)

Here Comes the Sun

Texas A&M Agriculture, part of the Texas A&M University System, will continue bioenergy research on sorghum uses, ranging from feedstock to ethanol production. It will be funded in part by more than $2.5 million from the Sun Grant Initiative, which is funded by the U.S. Department of Transportation.

The Texas Agricultural Experiment Station has developed a sorghum that can yield 15-20 dry tons per acre and stands up to 20 feet tall.

"Sorghum is a premier, dedicated feedstock for biofuels that is sustainable within existing agricultural production systems," says Mark Hussey, director of Texas A&M Agricultural Experiment Station.

(Clint Shields)

Women-Owned Businesses Fuel Sales

Companies that buy from women-owned businesses have an advantage in today's economy.

Seventy-nine percent of respondents in a 2007 study commissioned by the Women's Business Enterprise National Council said they would try a company's product or services if they knew the company bought from women-owned businesses.

Eighty-one percent of respondents said that awareness of a company's mission to buy from women-owned businesses would moderately or significantly solidify their brand loyalty to that company. The council surveyed 1,227 women consumers between the ages of 35 and 55.

"Corporations that have a history of buying from women-owned businesses will have an instant competitive advantage with the most powerful purchasers in the marketplace today," says Linda Denny, president and CEO of the group.

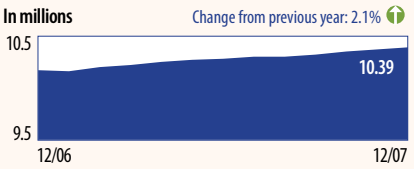
For more information on this study, go to *www.wbenc.org* or call *(202) 872-5515*.

(Karen Hudgins)

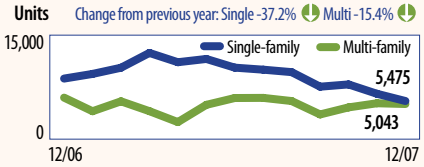
Key Texas Economic Indicators

Although the economy grew more slowly in 2007 than in 2006, Texas added more jobs than any other state in 2007. In fact, Texas added more jobs than second-place Florida and third-place California combined. Also, the Texas unemployment rate dropped below the national average during 2007, for the first time since 2001. Two reasons for the comparatively better economy in Texas are a greater concentration of the strong oil and gas industry in Texas and a housing market that has dropped less precipitously than the national average.

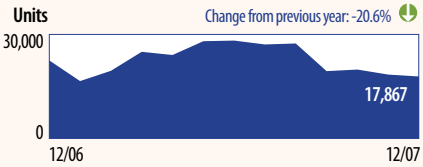
Non-farm Employment



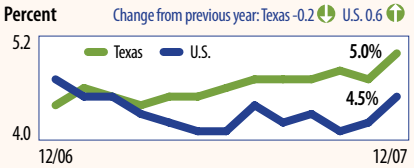
Housing Permits



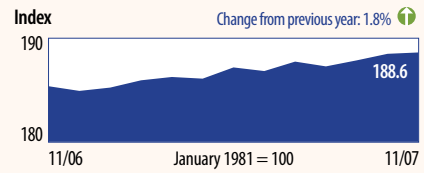
Existing Single-family Home Sales



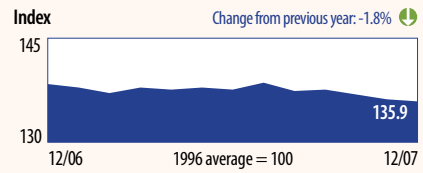
Unemployment Rate



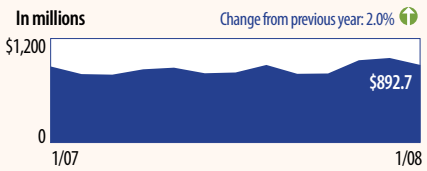
Leading Indicators Index



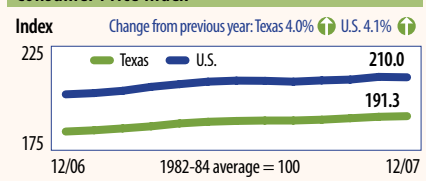
U.S. Leading Indicators Index



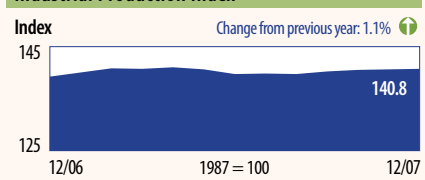
State Sales Tax Collections, Retail Establishments



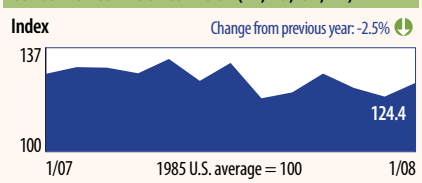
Consumer Price Index



Industrial Production Index



Consumer Confidence Index (Tx, La, Ok, Ar)



Texas Production and Consumption Indicators

	Crude Oil Production	Natural Gas Production	Active Oil & Gas Drilling Rigs	Motor Fuels Taxed		Median Sale Price, Existing Single-family Home	Auto Sales	Cigarettes Taxed
	Value	Value	Units	Gasoline	Diesel	Dollars	Net Value	Packages of 20
Date	(Millions)	(Millions)		(Millions of Gallons)			(Millions)	(Millions)
2006	$19,657.5	$19,852.1	746	11,372.8	3,731.6	$143,100	$45,756.2	1,280.2
2007	21,341.1	N/A	834	11,624.8	3,886.9	147,500	48,500.6	1,085.8
Nov-06	$1,433.2	$1,745.1	778	969.3	326.5	$142,300	3,989.7	124.6
Dec-06	1,524.7	1,892.9	780	942.2	299.9	145,800	3,436.7	117.3
Jan-07	1,323.2	1,567.5	790	963.1	300.9	138,300	3,336.3	75.0
Feb-07	1,350.6	1,762.5	813	923.2	299.5	140,600	3,669.5	68.5
Mar-07	1,542.7	2,065.5	818	880.2	304.8	144,800	3,717.8	96.9
Apr-07	1,558.2	2,027.1	824	968.2	369.2	146,300	4,128.7	109.7
May-07	1,557.8	2,343.3	829	983.1	248.5	149,300	4,233.3	92.3
Jun-07	1,556.1	2,373.5	834	1,002.3	326.8	155,000	4,227.3	89.5
Jul-07	1,769.9	2,240.3	831	978.2	326.3	152,100	4,159.0	96.2
Aug-07	1,790.1	2,060.7	844	974.3	320.5	152,700	4,368.3	151.3
Sep-07	1,983.4	1,897.5	837	1,021.1	360.6	146,900	4,383.8	29.3
Oct-07	2,256.7	2,251.8	842	939.6	315.9	142,900	4,294.2	96.1
Nov-07	2,382.6	1,964.6	860	1,025.7	371.5	144,600	4,303.5	92.8
Dec-07	2,270.0		884	965.8	342.4	147,400	3,678.9	88.2
Jan-08			858	985.8	313.7		3,828.5	76.7

Notes:

Crude oil and natural gas figures are net taxable values. Gasoline gallons include gasohol. Auto sale values are calculated from motor vehicle taxes collected on new and used vehicle sales. All figures are seasonally adjusted, except for sales tax collections; rigs; consumer price; housing permits/sales/prices; and consumer confidence. Figures are based on most recent available data. Annual figures are for calendar years.

Sources:

Key Economic Indicators:
Non-farm Employment: Texas Workforce Commission
Texas Housing Permits (Single- Multi-family), Existing Single-family Home Sales: The Real Estate Center at Texas A&M University
Unemployment Rate: Texas Workforce Commission, U.S. Bureau of Labor Statistics
Texas Leading Indicators Index, State Sales Tax Collections, Retail Establishments: Texas Comptroller of Public Accounts
U.S. Leading Indicators Index: The Conference Board
Texas Consumer Price Index: U.S. Bureau of Labor Statistics
Industrial Production Index: Federal Reserve Bank of Dallas
Consumer Confidence Index: The Conference Board

Texas Production and Consumption Indicators:
Crude Oil, Natural Gas, Motor Fuel, Auto Sales, Cigarettes: Texas Comptroller of Public Accounts
Active Oil & Gas Drilling Rigs: Baker-Hughes Incorporated
Median Sale Price, Existing Single-family Home: The Real Estate Center at Texas A&M University

December Cash Condition[1]

(Amounts in millions)	General Revenue	Other Funds	Total Cash
Beginning Balance December 1, 2007	$6,853.2	$16,469.0	23,322.2
Revenue/Expenditures			
Revenue	6,282.4	1,519.6	7,802.0
Expenditures	5,403.8	1,666.7	7,070.5
Net Income (outgo)	878.6	-147.1	731.5
Net Interfund Transfers and			
Investment Transactions	-179.6	-9.3	-188.9
Total Transactions	699.0	-156.4	542.6
End Cash Balance December 31, 2007[2]	**$7,552.2**	**$16,312.6**	**$23,864.8**

[1] Cash stated is from the Comptroller's Uniform Statewide Accounting System (USAS) and will vary from the amounts reflected in the cash accounts of the Treasury Operations Division of the Comptroller's office due to timing differences. Net amounts shown (less refunds) exclude funds that are authorized to be held outside the State Treasury and are not processed through USAS. Suspense and Trust Funds are included, as are unemployment compensation trust funds collected by the state but held in the Federal Treasury. Totals may not add due to rounding.

[2] The ending General Revenue Fund Balance includes $4.9 billion derived from the sale of cash management notes.

State Revenue/All Funds[1]

(Amounts in millions)	Monthly Revenue Dec. 2007	Fiscal Year-to-Date Sept. 2007-Dec. 2007 Revenue	% Change YTD/YTD
Tax Collections by Major Tax			
Sales Tax	$1,838.7	$7,028.1	7.2%
Oil Production Tax	106.7	373.8	35.1
Natural Gas Production Tax	191.8	692.0	19.9
Motor Fuels Taxes (Gasoline, Diesel, LPG)	256.5	1,058.1	3.8
Motor Vehicle Sales/Rental and			
Manufactured Housing Taxes	252.5	1,116.6	7.7
Franchise Tax	-54.2	108.5	4.3
Cigarette and Tobacco Taxes	127.5	452.5	120.4
Alcoholic Beverages Taxes	57.7	243.3	7.6
Insurance Taxes	13.4	57.6	-1.7
Utility Taxes[2]	-9.4	124.4	-7.6
Inheritance Tax	1.4	4.1	76.1
Hotel and Motel Tax	24.6	116.5	9.5
Other Taxes[3]	7.2	180.7	-23.4
Total Tax Collections	**$2,814.3**	**$11,556.1**	**9.7%**
Revenue by Receipt Type			
Tax Collections (see above)	$2,814.3	$11,556.1	9.7%
Federal Income	2,390.1	8,436.4	12.4
Interest and Investment Income	293.4	1,045.4	19.9
Licenses, Fees, Permits, Fines and Penalties	720.3	2,421.9	31.0
Employee Benefit Contributions	442.7	1,382.6	49.5
Sales of Goods and Services	38.3	145.9	14.3
Land Income	69.2	301.2	2.2
Net Lottery Proceeds[4]	124.1	533.1	10.7
Other Revenue Sources	909.6	5,642.1	136.9
Total Net Revenue	**$7,802.0**	**$31,464.6**	**26.0%**

[1] Excludes revenues for funds that are authorized to be held outside the State Treasury and are not processed through USAS. Totals may not add due to rounding.

[2] Includes the utility, gas utility administration and public utility gross receipts taxes.

[3] Includes the cement and sulphur taxes and other occupation and gross receipt taxes not separately identified.

[4] Gross sales less retailer commissions and the smaller prizes paid by retailers.

State Expenditures/All Funds[1]

(Amounts in millions)	Monthly Expenditures Dec. 2007	Fiscal Year-to-Date Sept. 2007-Dec. 2007 Expenditures	% Change YTD/YTD
By Object			
Salaries and Wages	$835.7	$3,305.9	4.4%
Employee Benefits/			
Teacher Retirement Contribution	689.8	2,754.5	8.9
Supplies and Materials	79.1	318.9	23.0
Other Expenditures	219.9	925.6	13.3
Public Assistance Payments	3,113.2	10,783.6	19.3
Intergovernmental Payments:			
Foundation School Program Grants	607.6	11,814.4	35.4
Other Public Education Grants	1,036.5	1,492.2	3.4
Grants to Higher Education	102.9	455.4	8.0
Other Grants	200.9	747.5	12.4
Travel	11.7	48.1	11.0
Professional Services and Fees	110.9	723.2	5.4
Payment of Interest/Debt Service	41.0	265.8	25.2
Highway Construction and Maintenance	436.7	1,974.1	-10.8
Capital Outlay	32.2	156.9	40.9
Repairs and Maintenance	50.2	233.0	9.8
Communications and Utilities	34.8	148.9	-24.6
Rentals and Leases	23.4	94.5	4.8
Claims and Judgments	7.3	48.3	82.6
Cost of Goods Sold	41.1	264.7	14.9
Printing and Reproduction	3.2	14.1	-9.0
Total Net Expenditures	**$7,070.5**	**$36,569.5**	**17.6%**
By Function			
General Government			
Executive	$417.5	$1,784.0	8.5%
Legislative	9.8	43.3	5.0
Judicial	16.4	80.7	0.1
Subtotal	443.7	1,908.0	8.0
Health and Human Services	2,952.9	10,325.7	17.6
Public Safety and Corrections	335.7	1,481.7	10.2
Transportation	622.0	2,823.4	-5.3
Natural Resources/Recreational Services	154.6	650.0	10.3
Education	1,807.5	16,325.3	26.6
Regulatory Agencies	20.4	110.7	33.7
Employee Benefits	601.7	2,387.8	9.6
Debt Service—Interest	41.0	265.8	25.2
Capital Outlay	32.2	156.9	40.9
Lottery Winnings Paid[2]	58.7	134.1	-6.3
Total Net Expenditures	**$7,070.5**	**$36,569.5**	**17.6%**

[1] Excludes expenditures for funds that are authorized to be held outside the State Treasury and are not processed through USAS. Totals may not add due to rounding.

[2] Does not include payments made by retailers. Previously shown as "Other expenditures."

Some revenue and expenditure items have been reclassified, changing year-to-date totals. The ending cash balance is not affected because changes reflected in "total net revenues" and "total net expenditures" offset changes in "net interfund transfers and investments transactions" in the cash condition table.

Revenues and expenditures are reported for the most recent month available and as a running total for the current fiscal year-to-date. In addition, year-to-date figures are compared with the same period in the last fiscal year. These comparisons are reported as percentage changes, which may be positive or negative (shown by a minus sign).

Trust fund transactions are included within revenues and expenditures in the "all funds" presentations. Trust funds are not available to the state for general spending.

Texas Stats Production: Tyra Peterson, Public Outreach and Strategies Division
Economic Data: Dean Ferguson, Winfred Kang, Gary Preuss, Revenue Estimating Division
State Financial Tables: Ann Zigmond, Fund Accounting Division

SUSAN COMBS
Texas Comptroller of Public Accounts

FISCAL NOTES is one of the ways the Comptroller's office strives to assist taxpayers and the people of Texas. The newsletter is a by-product of the Comptroller's constitutional responsibilities to monitor the state's economy and to estimate state government revenues.

FISCAL NOTES also provides a monthly summary of the financial statements for the State of Texas.

Articles and analysis appearing in *FISCAL NOTES* do not necessarily represent the policy or endorsement of the Texas Comptroller of Public Accounts. Space is devoted to a wide variety of topics of Texas interest and general government concern.

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